

ROBOTIC RANGE CLEARANCE COMPETITION (R2C2) COMPETITION LESSONS LEARNED

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This presentation provides an overview of lessons learned from previous range clearance operations and how they are important factors to be considered in the Robotics Range Clearance Competition (R2C2).							
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R2C2 Range Clearance Lessons Learned at AFRL

Air Force Research Laboratory

Airbase Technologies Division

Tyndall Air Force Base, Florida

Force Protection Branch Robotics Research Team 850-283-3725

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Introduce self.



Overview

- Personnel
- Communication
- Cameras
- Equipment Versatility
- Attachment Selection
- Equipment Health
- Common User Interface
- Particulate Management
- · Hydraulic Fluid

- Critical Component Selection
- Redundant Safety
 Radio
- Spares
- Things that can go wrong

Introduce the overview of what the presentation will cover.



Personnel

- · Have dedicated personnel
 - Mechanics
 - Technicians
 - Safety Personnel
 - Up to 40% of time is taken up with vehicle maintenance



Communications

- · Line of Site
 - May need repeaters due to topography
- · Bandwidth
 - May need separate control and video radios
- Heat
 - Solar loading is a frequent failure point
- Frequency Management
 - Keep radios from stepping on each other
 - Frequencies used by installations includes frequencies used by visiting units
 - Modular Systems
 - Tunable Radios
 - FCC regulations apply



Cameras

- Have auto iris and gain control
- Placement
 - Operators have limited FOV so cameras can be knocked off or damaged inadvertently
 - Protection from obstacles and debris
- · Day and night operations







Describe the ARTS, its attachments, and how they can be used to improve range clearance.



- Hydraulic/Electrical Power necessary to operate the attachment
 - Some may need additional power packs
 - Matching attachments to the equipment (weight / power requirements)
- · Magnets are strong enough to pick up debris
- Mulchers may need teeth replacement or repair







Barber Surf Rake

- Able to pick up small items comparable to a quarter and as large as a coffee can with a weight of 10lbs or less.
- Anything larger destroys tines and could jam machine
- Excellent for open areas with minimal vegetation





Harley Rock Picker

- Able to pick up small items comparable to a quarter based on screen size and as large as a 155mm.
- Replaceable screens for size control cleaner scrap piles
- Excellent for open areas with minimal vegetation
- No longer in production





FAE Mulcher

- Cots system that was designed with flail hammers
- AFRL modified to have solid replaceable teeth
- Good for mulching 4" trees and under growth
- Leaves good mulch with minimal stumps and branches





Equipment Health

- Have sensors on board to monitor critical items. Operators only know what the user interface tells them.
 - Hydraulic fluid levels
 - Engine operating data
 - · Oil pressure
 - · Oil temperature
 - · Coolant temperature
 - Fuel Levels
 - Electrical load



Particulate Management

Fine particle and dust will get into your gear.
 Add filters to inlet and outlet ports.





Fluids

- · Hydraulic Fluid
 - Get biodegradable where possible
- Coolant
 - Get biodegradable where possible
- · Oils
 - Have spill kits close
- · Spill cleanup
 - Must comply with all DOD and EPA regulations (check on installation Regs)





Things that can go wrong

- · Broken hydraulic hoses
- Vehicle turnovers
- Loss of communications due to antenna failures
- · Brush hog blades breaking
- · Mulcher Teeth breaking
- Barbed wire entanglement
- Detonation of UXO
- Unauthorized intrusion on range during operations





Robotic Range Clearance Competition Terrain/Soil Condition Issues

- · Slopes and hills
 - Slide hazards, roll over and just plain stuck
- Type of soil
 - Sand
 - Clay
 - Rock
- Weather/rain
 - Make clay slick
 - Makes sand heavy
 - Can impact load bearing capacity





Subsurface Objects

- Excavator worked best for items up to 15' deep
- Excavators have also removed debris from shallow water

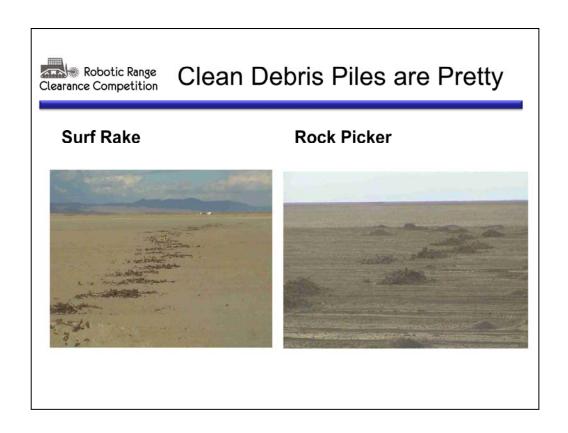




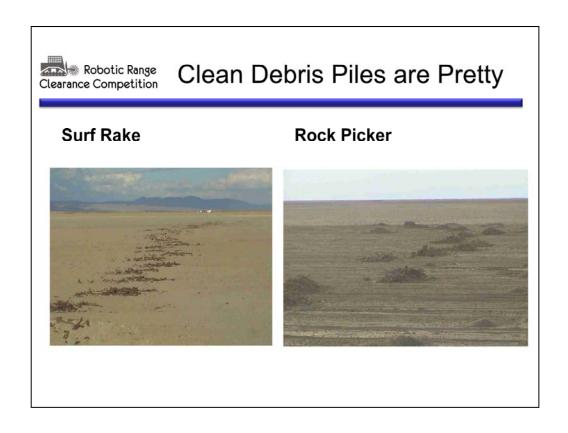
Towing Sensors

- Vehicle has proper hitch or connection point
- Vehicle has proper power take-off (PTO) points if necessary
- Vehicle can match the ideal speed for the sensor











Magnet Soil Interaction

- Magnets will not affect post job EM surveys
- Magnets will affect magnetometers





Wrap Up

- What you don't think will break will
- Adapt to the conditions in the field

Wrap up presentation.